**Remarks:**

Applicants submit the following comments in response to the Office Action.

## 1. Election/Restrictions

As filed, the Subject Application included claims 1-98. In response to a restriction requirement, Applicant elected claims 1-28 for further prosecution. Therefore, claims 1-28 should remain under examination in the Subject Application. Nevertheless, the Examiner indicates in the Office Action that he has withdrawn claims 6, 8, 23-24, and 27-28 from further consideration "pursuant to 37 CFR 1.142(b) as being drawn to a nonelected species, there being no generic or linking claims." (Emphasis added.) Applicant respectfully submits that withdrawing claims 6, 8, 23-24, and 27-28 under the present facts is improper and submits that those claims should be examined along with the other elected claims in response to the restriction requirement. First, the language in Rule 1.142(b) relating to withdrawal of claims is directed to claims that are not elected in response to a restriction requirement, and that rule does not relate to an election of species. Here, Applicant elected the Examiner's Group I, including each of claims 1-28.

Second, MPEP section 806.04, "Genus and/or Species Inventions", states as follows:

> Where an application includes claims directed to different embodiments or species that could fall within the scope of a generic claim, restriction between the species may be proper if the species are independent or distinct. However, 37 CFR 1.141 provides that an allowable generic claim may link a reasonable number of species embraced thereby. The practice is set forth in 37 CFR 1.146.

37 C.F.R. § 1.146, "Election of species", in turn, reads as follows:

> In the first action on an application containing a generic claim to a generic invention (genus) and claims to more than one patentably distinct species embraced thereby, the examiner may require the applicant in the reply to that action to elect a species of his or her invention to which his or her claim will be restricted if no claim to the genus is found to be allowable. However, if such application contains claims directed to more than a reasonable number of species, the examiner may require restriction of the claims to not more than a reasonable number of species before taking further action in the application.

As suggested in the above passages, and as confirmed by Rule 1.141(a), including claims directed to several independently patentable species in a patent application is perfectly acceptable so long as they are linked by a generic claim. That is the case with respect to claims 6, 8, 23-24, and 27-28 of the Subject Application: claims 6 and 8 are linked to other claims within Group I by independent claim 1; and claims 23-24 and 27-28 are linked to other claims within Group I by independent claim 11. Thus, claims 6, 8, 23-24, and 27-28 should be examined if and when those generic claims are found to be allowable.

**2. <u>Claim Rejections – 35 U.S.C. § 103(a)</u>**

**a. Claims 1-5, 7, 9, and 11**

The Examiner rejects claims 1-5, 7, 9, and 11 under 35 U.S.C. § 103(a) as having been obvious over Aries et al., "Effect of Stabilizing Heat Treatment on Characteristics of Electrolytic Alumina Coating on Ferritic Stainless Steel" ("Aries"). Of these rejected claims, claims 1 and 11 are independent claims. Claim 1 is directed to a method of making a ferritic stainless steel having an oxidation resistant surface, wherein the method comprises "modifying at least one surface of the ferritic stainless steel...." Rejected claims 1-5, 7, and 9 each directly or ultimately depend from claim 1. Independent claim 11 also is directed

to a method of making a ferritic stainless steel, but wherein the method comprises "electrochemically modifying at least one surface of the ferritic stainless steel".

In the present Response, Applicant amends claims 1 and 11 to include the limitation that the steps of "modifying at least one surface" (claim 1) and "electrochemically modifying at least one surface" (claim 11) "remove material from the at least one surface". Such an amendment is amply supported by the Subject Application, which, for example, describes embodiments of a method wherein at least one surface of a ferritic stainless steel is modified by electropolishing the surface. As is known in the art, electropolishing is an electrochemical modification process wherein a portion of a metal or metal alloy surface is electrolytically removed.

Aries describes a process that substantially and fundamentally differs from the methods recited in claims 1 and 11, as amended herein. Aries describes a process wherein <u>a ceramic coating of an externally applied compound is applied to a surface of the alloy</u> using a cathodic treatment and a heat treatment step. For example, section 2.1 of Aries begins by stating that "[d]eposits were prepared on an Fe-17% Cr ferritic stainless steel...." More specifically, Aries describes a process wherein a stainless steel that is essentially free (0.09%) of aluminum (see Table 1 of Aries) is coated with an aluminum-containing compound (boehmite) by using the stainless steel as a cathode in what is essentially a plating bath. For example, section 2.1 of Aries explains that "[c]athodic <u>deposition</u> of aluminum hydroxide [on the stainless steel] was performed using a platinum electrode as anode and a saturated calomel reference electrode (SCE) from a saturated aqueous solution of aluminum phosphate at a potential of -3V for 30 minutes." (Emphasis added.) Section 4 of Aries, for example, explains that "the electrolytic deposit [formed on the stainless steel] is an amorphous boehmite gel with a superficial cracked mud morphology." The coating was then dried at 70°C for 10 minutes.

The technique of Aries employs a subsequent thermal treatment, wherein the samples were heated at 8900°C for 1 hour, to stabilize the coating deposited on the stainless steel surface. As noted in section 3.1 of Aries, heating in this way stabilized and modified the coating to form small crystals within the coating and form a "compact structure over the entire surface." As further described in section 3.1, Aries determined that the compact coating formed upon heating consisted of (1) an inner layer that is a modified form of the primary conversion coating on the steel, with a thickness that is the same as that of the initial conversion coating; and (2) a second layer, containing only aluminum compounds deposited <u>on the steel surface during the initial cathodic treatment</u>. Aries subsequently re-heated coated samples at 800°C for varying times of 5, 10, and 24 hours and considered what changes occurred in the samples' coatings. As noted in section 3.2.1 of Aries, after re-heating at 800°C the coatings included three layers: a superficial layer consisting mainly of alumina and other aluminum compounds; an intermediate zone rich in chromium compounds; and an internal layer including iron compounds.

Thus, Aries plainly describes <u>adding material</u> in the form of a multi-layer coating to a particular ferritic stainless steel alloy. In contrast, the methods recited in claims 1 and 11, as amended herein, involve <u>removing material</u> from at least a surface of the stainless steel. Also, the "electrically conductive, aluminum-rich, oxidation resistant oxide scale" recited in claim 1 is formed on, and at least partially arises from, the ferritic stainless steel when the modified surface of the steel is subjected to oxidizing conditions – the oxide scale recited in claim 1 is not artificially added to the surface as in Aries.

Also, as noted above, Aries involves coating the surface of a stainless steel that includes a relatively minor amount of aluminum. Table 1 of Aries lists 0.09 weight percent of aluminum. In contrast, claims 1 and 11 are amended herein to recite that the ferritic stainless steel includes at least 0.2 weight percent aluminum, an amendment that is clearly supported by the Subject Application as filed. That 0.2 weight percent minimum aluminum content is more than twice the

amount of aluminum in the alloy described in Aries. Without intending to limit the Subject Application's claims in any way, it is believed that the present invention at least in part relies on the presence of sufficient aluminum (at least 0.2 weight percent) and greater than 0.02 weight percent of rare earth metal(s) in the ferritic stainless steel. This combination is believed to work in conjunction with the recited modification of at least one surface of the stainless steel to enhance the oxidation resistance of the surface relative to the oxidation resistance of an unmodified surface. Thus, it is believed that even if Aries did disclose or suggest electropolishing or otherwise modifying a surface of the stainless steel to remove material from the surface, which it does not, the increased oxidation resistance produced by methods included in the present invention would not be achieved.

Accordingly, Aries does not disclose the methods recited in claims 1 and 11, as amended herein. Aries also does not suggest or otherwise render obvious the methods recited in amended claims 1 and 11. Applicant respectfully requests that the Examiner withdraw the rejection of these claims and pass them, along with dependent claims 2-5, 7, and 9, to allowance.

**b. Claims 11-13 and 15-22, and 25-26**

The Examiner rejects claims 11-13, 15-22, and 25-26 as having been obvious over U.S. Patent No. 4,097,311 to Ishibashi ("Ishibashi"). Claim 11 is the single independent claim among this group of rejected claims. Claim 11 is amended herein to recite that the ferritic stainless steel includes at least 0.2 weight percent aluminum, and to recite that electrochemically modifying the at least one surface of the steel includes removing material from the at least one surface. Ishibashi describes a method for preparing a surface of an alloy component in a solar collector so that the surface advantageously absorbs solar radiation. The method described in Ishibashi includes processing an alloy substrate so that it has a "mirror-like surface of [a] predetermined roughness", and then tightly adhering a coating or film of a predetermined metal oxide to the mirror-like surface. The metal oxide is selected so that, when applied as a film to the mirror-like surface, it has the effect of selectively absorbing solar radiation

and preventing reflection of the solar radiation from the surface. See Ishibashi at col. 2, lines 39-44. The techniques discussed in Ishibashi used to form the metal oxide film on the prepared mirror-like surface of the substrate include (1) subjecting the surface to a wet or dry chemical treatment, such as by applying to a particular acidic or alkaline oxidizing composition to the surface; (2) using vacuum evaporation coating techniques, such as "spattering" or arc discharge techniques; (3) adhering metal oxide powders to the surface using a polymeric or other binder that is relatively transparent to infrared radiation; and (4) simultaneously adhering and oxidizing a stainless steel coating on the mirror-like surface, such as by "chromalyzing" or cladding, wherein the stainless steel differs from the surface. See Ishibashi at col. 4, lines 26-45 and col. 8, lines 10-25. Ishibashi explains that the oxide film formed on the mirror-like surface has a thickness in the range of 500-2000 Angstroms. Col. 10, lines 29-38. Thus, the processed surface of the substrate in Ishibashi is not left exposed, but instead is coated with a relatively thick layer of a metal oxide material having certain spectral properties facilitating absorption of solar radiation by the surface.

The method of claim 11 does not include a step of forming a metal oxide coating on the electrochemically treated surface. Instead, the electrochemically treated surface itself becomes "oxidation resistant", and at least a region of the treated surface remains exposed in service and is subjected to the particular oxidizing environment inherent in the application in which the stainless steel is used. In order to emphasize this substantial distinction between the method of claim 11 and the technique described in Ishabashi, Applicant herein amends claim 11 to recite that the method is for making "a ferritic stainless steel article having an <u>uncoated electrochemically treated</u> oxidation resistant surface." As used in claim 11, "uncoated" is intended to mean that a material is not <u>applied to or deposited on</u> the surface as a film or other coating; "uncoated" is not intended to exclude, for example, conversion coatings such as oxide coatings that arise from oxidation of the treated surface.

For at least the foregoing reasoning, the method recited in claim 11 is neither disclosed nor suggested by Ishibashi, and the rejection of claim 11 should be withdrawn. Each of dependent claims 12, 13, 15-22, and 25-26 ultimately depend from claim 11 and, therefore, it is submitted that the Examiner also should withdraw his rejection of these claims.

Applicant also notes that claim 13 recites that the "electropolished surface develops an aluminum-rich oxide scale comprising iron and chromium and having a hematite structure, $a_o$ in the range of 4.95 to 5.04 Å and $c_o$ in the range of 13.58 to 13.75 Å, when heated in an oxidizing atmosphere for at least 100 hours at a temperature in the range of 750°C to 850°C." In Ishibashi, of course, the mirror-like surface is coated with a relatively thick film of a predetermined metal oxide. Given that fact, it is believed that the coated mirror-like surface could not possibly develop an oxide scale having the attributes recited in claim 13. Thus, claim 13 is neither disclosed nor suggested by, or inherent in, anything described in Ishibashi.

**c. Claim 10**

The Examiner rejects claim 10 under § 103(a) as having been obvious over Horita et al., "Stability of Fe-Cr Alloy Interconnects under $CH_4$-$H_2O$ Atmosphere for SOFCs" ("Horita"). The Examiner asserts that Horita describes a stainless steel within the composition recited in claim 10, and further describes modifying a surface of the stainless steel so that the modified surface develops a scale as recited in claim 10. With regard to "modifying" a surface of the stainless steel, Horita describes annealing the steel at 1073 K under a $CH_4$-Ar saturated with $H_20$.

Claim 10 is amended herein to recite that modifying the at least one surface includes removing material from the at least one surface. As discussed above, such an amendment is supported by the Subject Application as filed. Horita neither describes nor in any way suggests modifying a surface of the alloys in Horita by removing material from the surface. Instead, Horita describes simple high temperature oxidation of the alloys described in Horita. The

thermally-induced oxide scale in Horita consists of two layers: an outer $MnCrO_4$ spinel layer; and an inner $Cr_2O_3$ layer lacking appreciable aluminum and iron. It is believed that such a coating will form on any Fe-Cr, Fe-Cr-Mo, Fe-Ni-Cr, or Fe-Ni-Cr-Mo stainless steel and on any Ni-Cr, Ni-Cr-Fe, Ni-Cr-Mo-Fe nickel-base alloy including, for example, 15-17 weight percent chromium and greater than 0.5 weight percent manganese. This conventional conversion coating, in fact, is the general basis for corrosion resistance exhibited by all stainless steels and nickel-base alloys used at high temperatures.

In contrast, claim 10 recites that when the modified surface is heated in an oxidizing atmosphere for at least 100 hours at 750-850°C, it develops an aluminum-rich oxide scale comprising iron and chromium and having a hematite structure, $a_o$ in the range of 4.95 to 5.04 Å, and $c_o$ in the range of 13.58 to 13.75 Å. The scale described in Horita is not aluminum-rich. Instead, Horita states that $Al_2O_3$-rich dark spots were formed in the alloy (not the scale) of certain of the oxidized samples, and those spots occupy only a very small fraction of the overall surface shown in the micrograph of Figure 6(a).

For at least the foregoing reasons, Horita neither discloses nor in any way suggests the method recited in claim 10, as amended herein. As such, the rejection of claim 10 should be withdrawn.

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**Conclusion:**

Applicant respectfully submits that all of the claims under examination are in condition for allowance. Applicant's response should not in any way be taken as acquiescence to any of the specific assertions, statements, etc., presented in the Office Action not explicitly addressed herein. Applicant reserves the right to specifically address all such assertions and statements in subsequent responses.

Applicant has made a diligent effort to properly respond to the Office Action and hereby traverses all rejections presented. If the Examiner has any remaining concerns, the Examiner is invited to contact the undersigned at the telephone number set forth below so that those concerns may be expeditiously addressed. Accordingly, Applicant earnestly requests reconsideration and withdrawal of all rejections and further earnestly requests allowance of all claims under examination.

Respectfully submitted,

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